Chemistry 236 -- Quiz 4

Lab Day ____

March 25, 2014 — Least Squares, Probability, and KaleidaGraph

Pledge and signature:

Note: If you want your paper returned folded (*i.e.*, score concealed), please print your name on the back.

1. (8) Consider the probability distribution, $P(x) = c\,(1 - x)$, defined over the range $0 \le x \le 1$. For this distribution, calculate: **(a)** the normalization constant, **(b)** the mean, **(c)** the variance, and **(d)** the standard deviation. Also, **(e)** give an equation that could be solved to obtain the median.

2. (7) (a) If you generate 10^4 random numbers having this distribution, how many are expected to fall within the x range 0.0–0.10? What is the standard deviation of this value?

(b) Suppose you now generate 10^4 random quantities, each an *average* of 12 random deviates having this distribution, and you then histogram these results into 10 bins of width 0.1 each. Describe the resulting histogram, and give its approximate mean and standard deviation.

3. (6) We often fit data to polynomials in $(x-x_0)$ (x_0 a constant) to smoothly represent data.

(a) Using the General routine of KaleidaGraph in trial-and-error fashion for such fitting, under what conditions can you drop a term from the fit to obtain a statistically better fit (i.e., smaller s_y^2) having one fewer adjustable parameters?

(b) Suppose you fit thermistor calibration data for the region 19-34° C to a cubic polynomial. What is an easy way to get the statistical uncertainty in the calibration correction at 29°C ?

(c) Write **exactly** what you must enter in the Define Fit box to carry out such a cubic fit, taking x_0 to be 25.

4. (6) Suppose t, u, and v have % uncertainties of 2.0%, 4.0%, and 5.0%, respectively. If $x = 5u^{-1/2}$, $y = 7\,v/u$, and $z = 10\,t^3\,v^2/u$, what are the % uncertainties in x, y, and z?